

**TDP (Honours) 5th Semester Exam., 2023**

**PHYSICS**

(Honours)

**TWELFTH PAPER : CC – 12**

*Full Marks : 60*

*Time : 3 Hours*

*Answer from **both** the Sections as directed.*

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers  
in their own words as far as practicable.*

**SECTION—A**

**1. Answer *any six* of the following questions :**

$2 \times 6 = 12$

- (a) Write the basic difference between covalent and metallic bondings.
- (b) State Wiedemann-Franz law.
- (c) What are primitive lattice cell and unit cell?
- (d) Define Cooper pair.
- (e) What is ferromagnetic domain?
- (f) Define critical magnetic field.
- (g) What is electrostrictive effect?
- (h) What is reciprocal lattice?

( 2 )  
**SECTION—B**

There are *four* questions from Question No. 2 to Question No. 5. Answer either (a) or (b) from each question given below :  $12 \times 4 = 48$

- 2.** (a) (i) What is interplanar distance of lattice planes? With a clear diagram, find the interplanar distance of a lattice plane taking the lattice to be cubic with  $a = b = c = 2 \text{ \AA}$ .
- (ii) Find the Miller indices of a set of parallel planes which make intercepts in the ratio of  $3a : 4b$  on the  $x$  and  $y$  axes and are parallel to  $z$  axis,  $a, b, c$  being primitive vectors of the lattice.
- (iii) "Bragg's law is a consequence of the periodicity of the space lattice." Explain.  $(1+3)+4+4=12$

**( OR )**

- (b) (i) Constructing the primitive vectors, show that the f.c.c. lattice is a reciprocal of b.c.c. lattice.
- (ii) The Bragg angle corresponding to the first order reflection from (111) planes in a crystal is  $30^\circ$  when X rays of wavelength  $1.75 \text{ \AA}$  are used, calculate the interatomic spacing.
- (iii) Write short notes on Brillouin zone and van der Waals bonding.  $4+4+(2+2)=12$

( 3 )

3. (a) (i) What do you mean by lattice vibration? Write a brief qualitative description of phonon.
- (ii) Classically show that the heat capacity of solid element is proportional to  $R$ .
- (iii) Write the discripencis in the classical theory of specific heat. How did Einstein correct the classical law of specific heat?
- (1+3)+4+(2+2)=12

( OR )

- (b) (i) Write short notes on mobility and conductivity. Define drift velocity.
- (ii) Explain the Drude-Lorentz theory related to free electron.
- (iii) Write the basic difference between ordinary gas and free electron gas. Define density of states.
- (3+1)+4+(2+2)=12

4. (a) (i) Write the basic theory of Hall effect. Set a relation between the Hall coefficient and applied magnetic field.
- (ii) What is superconductor? How does a conductor transform to a superconductor?
- (iii) How does the effective mass of electron vary with acceleration of the electrons moving in the periodic lattice?
- (2+2)+(2+2)+4=12

( 4 )  
( OR )

- (b) (i) Using Kronig-Penney model, explain the formation of Brillouin zone and forbidden zone.
- (ii) Using London equation, calculate the penetration depth.
- (iii) Explain the 'electron-lattice-electron' interaction using BCS theory.

$$(4+2)+3+3=12$$

5. (a) (i) Write the description of dia-, para- and ferromagnetic materials.
- (ii) Give an account of Langevin's theory of diamagnetism.
- (iii) How does a paramagnetic susceptibility vary with temperature? What is Curie-Weiss law?

$$4+4+(2+2)=12$$

( OR )

- (b) (i) What is polarization mechanism of di-electric substance?
- (ii) Derive the classical theory of electrical polarizability.
- (iii) Explain the structural piezoelectric effect and pyroelectric effect.
- (iv) Explain Clausius-Mossotti equation.

$$3+4+3+2=12$$

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